

WASHINGTON

SCIENCE TRENDS

HIGHLIGHTS

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* MEASUREMENT RESEARCH PROGRAMS

The National Bureau of Standards is planning a substantial increase in its programs for precision measurement and the calibration of standards to meet pressing "space age" requirements.

Here is a summary of some of the problems, and steps being taken:

- ✓ Technical Publications Program: Publications issued over a period of years, and in a variety of forms, are now being re-issued in a series of three handbooks, to be available in 1961. The Superintendent of Documents, Government Printing Office, Washington 25, D. C. is now taking orders for "Precision Measurement and Calibration" Vol. 1, "Electricity and Electronics" (\$6), Vol. 2, "Heat and Mechanics" (\$6.75) and Vol. 3, "Optics, Metrology and Radiation" (\$7).
- ✓ Microwave Power and Attenuation: Typical of problems cited by industrial representatives in recent conferences were the "trial and error" development of radomes due to lack of precise phase and amplitude measurement capabilities, and the practice of "over-design" of Klystron tubes. Two new services soon to be made available by the National Bureau of Standards may be of assistance in these fields. These are calibration services for waveguide power measurements in the frequency range 3.95 - 8.2 Gc and coaxial power measurements in the frequency range 300 Mc to 12.4 Gc.
- ✓ Internal Diameters and Surface Flatness and Finish: Inertial guidance systems and such developments as gas bearings have resulted in requirements for extremely close tolerances which are directly related to product function. One industry representative asserted that the cost of a large-quantity production item could be reduced from \$950 to \$250 if tolerances on bores and bearings could be held to 10 micro-inches. In the case of another item, it was stated that lack of sufficiently accurate measurement capabilities of hole sizes is requiring the construction of three \$25,000 units for every good one produced. Most spokesmen indicated that entirely new concepts are required for ultra-precise gaging.

Another problem discussed was "noisy" gyroscopes believed to be associated with surface finish characteristics. As a partial solution to this problem the Bureau will soon offer a calibration service for physical roughness standards.
- ✓ Gears: Industry has urged the Bureau to provide a calibration service for master gears, while organizing a strong research program looking toward the development of better methods. One industrial spokesman reported that his company rejected \$54,000 in gears for the first six months of 1960.

(continued)

MEASUREMENT RESEARCH PROGRAMS (Continued)

- ✓ Infrared Measurements: A major problem expressed by industry is the need for specification of a "standard wet atmosphere" as a basis for evaluating the performance of infrared systems. Lack of agreement on test conditions is said to be causing considerable difficulties between users and suppliers.
- ✓ Temperature and Humidity Measurements: Temperature measurement problems are prevalent in the very-low-temperature regions, where hydrogen and helium are liquids, and extensive industrial use is being made of superconducting circuits and of cryogenic inertial reference systems. In the intermediate range, precise temperature control within gyroscopes used in certain inertial reference systems is a problem. In the very-high temperature regions more accurate measurements are needed in the study of materials suitable for rocket throat linings. Standards and techniques for the measurement of exhaust gas temperatures are said to be "essentially non-existent". Obviously, the costs of improper design are large -- the cost of fuel alone in a single test firing of a certain rocket was estimated at \$125,000.

A limited increase in the accuracy of temperature measurements could provide important weight savings, the NBS was advised. In one case a savings of 250 pounds was effected, with a substantial improvement in range, through the reduction of measurement uncertainty from 10° to 2° F. In another case, it was demonstrated that improved temperature measurements available for determining the thermal conductivity of a heat shield would permit saving 125 pounds in the payload. This was translated into 12,500 pounds in the complete system.

The NBS hopes to make "substantial contributions" to some of these problems through two new services expected to be available by July, 1961 -- a calibration service for germanium resistance thermometers in the cryogenic region, and for very-high temperature thermocouples.

(Measurement Research Conferences have been sponsored by the Aerospace Industries Association. The next series of conferences will deal with radio frequency measurement problems and will be held at the NBS Boulder (Colo.) Laboratories this month. Tentatively scheduled for April is a series of meetings on shock, vibration, force and acceleration. Other areas are scheduled for attention later in the summer.)

* STRATOSCOPE II PROJECT: First test launching with a dummy payload is scheduled for early 1961 in the Stratoscope II project to loft a 4,300 pound, 30-inch telescope system to 80,000 feet for astronomical photographs. Vitro Laboratories has been awarded a program management contract for the project, which is under the direction of Prof. Martin Schwarzschild, Princeton University.

Balloon System -- A proposed balloon system to lift the telescope payload, under development by G. T. Schjeldahl Co., Northfield, Minn. will use a new material developed by the company for the Office of Naval Research. Known as S-10, the material is basically Mylar plastic reinforced with a dacron mesh.

Helicopter Recovery -- Also under development is a method of using a helicopter to capture the balloon and its payload as it descends. Initial test of a helicopter-towed device for snagging the balloon has been completed by the Naval Air Development Test Unit, South Weymouth, Mass. Target period for the first full-scale launch and recovery is Fall, 1961.

Telescope System -- The telescope is now under construction by its designers, the Perkin Elmer Co., Norwalk, Conn. Theoretical resolving power is to be 1/10th of a second of arc "or the ability to distinguish two golf balls 15 inches apart 500 miles away." The 36 inch optical mirror, fabricated by Corning Glass Works, Corning, N. Y., is said to be the largest of its kind ever cast and was ground to a true parabolic shape with a tolerance of one-millionth of an inch. At altitude, the telescope will be focused and monitored by a remote control television system and a 70-station command channel developed by RCA Laboratories, Princeton, N. J. A telemetry system will be provided by the Sierra Research Laboratory, Buffalo, N. Y.

TECHNICAL TRENDS

□ The Air Force is carrying on an extensive modification program to improve the reliability of the J79 engine lubrication system. Included is replacement of bearings in the main lube and hydraulic pump and the three bearing scavenge pumps. In addition, screens are being installed in the lubricating system to aid in preventing pump failure. The Air Force considers the modification program so urgent that operations are being conducted on a three-shift, seven-day week basis. ✓✓✓ General Motors, Cadillac Division, is making conceptual studies of an Armored Reconnaissance/Airborne Assault Vehicle under a cost-plus-fixed fee contract with Army Ordnance. ✓✓✓ American Machine and Foundry Co. has received an Ordnance contract to determine the best steering transmission for use in an hydraulic free piston engine. ✓✓✓ Jet Propulsion Laboratory, Pasadena, Calif. selected four companies to submit a design analysis of a large space tracking antenna of from 200 to 250 feet for use in advanced programs. Companies are Westinghouse Electric, Blaw-Know, Hughes Aircraft and North American Aviation.

□ The National Bureau of Standards, Office of Technical Information, Washington 25, D. C. has available details of changes in its standard frequency - time signal broadcasts which went into effect January 1, 1961. ✓✓✓ Technical characteristics of the side lobe suppression feature for the Air Traffic Control Radar Beacon System recommended by the Federal Aviation Agency are available upon request to FAA, Bureau of Research and Development, Room 5C216, Building T-5, Washington 25, D. C. ✓✓✓ General Electric Co. has received a Navy Bureau of Ships contract for study of single and multiple pneumatic servo-controlled vibration mounts. ✓✓✓ Firms having research and development capabilities in the field of meteorological field experiments to provide information describing "the mechanism of jungle canopy ventilation as well as the processes in undercanopy aerosol diffusion and transport" are being sought by the Army. For details write Dugway Purchasing Office, Room 183, GSA Building, 1750 S. Redwood Road, Salt Lake City, Utah.

□ A statistical report showing that total shipments of selected key atomic energy products registered a 50 percent gain in 1959 is available for 10 cents from the Publication Office, Bureau of the Census, Washington 25, D.C. Ask for Atomic Energy Products, Series M38Q-09. ✓✓✓ A solar furnace originally planned for Cloudcroft, New Mexico has reportedly been determined "not needed." A joint Air-Force and National Aeronautics and Space Administration Committee is said to be studying the situation to determine the kind of facility which should be built, with a combination solar system-electro optical observation activity under consideration. ✓✓✓ Tests indicate that the Army's YAC-IDH "Caribou" can transport and air dump loads up to a maximum of 6,740 pounds.

□ Officials of the Space Agency are pleased with results of the firing of a solid propellant rocket motor made by a new "building block" method under development by United Technology Corp., Sunnyvale, Calif. The motor was manufactured in three separate pieces, each weighing about one-half ton and assembled at the test site. The system may result in savings in development costs of the very large boosters and upper stages under consideration for advanced space missions. ✓✓✓ The Information Office, National Science Foundation, Washington 25, D. C. has available Announcement 60-13 detailing 376 new fellowship awards for science faculty members and postdoctoral studies. ✓✓✓ The U. S. Army Chemical Center, Md. is looking for paper manufacturing firms interested in producing wet process filter paper for gas masks. Details are available from the Center's Procurement Agency Office.

RESEARCH CHECKLIST

- ☐ PHOTOGRAPHIC TEMPERATURE DETERMINATION: Studies by the National Aeronautics and Space Administration indicate that photography can be used with satisfaction to measure elevated temperatures of surfaces. Since the photographic method produces a calibrated photograph of the heated surface, temperature contour maps can be made in detail for aerodynamic heating investigations. A method developed by NASA eliminates the need for identical emulsion batches and delicate development procedures.
- (Details available. Single Copies Free. Write National Aeronautics and Space Administration, ATTN: CODE BID, 1520 H Street, N. W. for NASA Technical Note D-617, "An Investigation of a Photographic Technique of Measuring High Surface Temperatures.")
- ☐ OCEANOGRAPHIC DATA DEVICE: A buoyant steel sphere that operates on the principle of a child's "yo-yo" is being tested by the Scripps Institute of Technology with U. S. Government support. The device may replace conventional instruments which are mounted on skiffs or rafts for the automatic recording of oceanographic data. These, it is reported, are often cut loose from their moorings by waves, currents and passing ships. Tests indicate that the "yo-yo" sphere would allow a 16-foot unpowered skiff to do much of the work of a 150-foot oceanographic research vessel.
- ☐ ZONE REFINING METALS: Studies sponsored by the Air Force have resulted in development of special apparatus for the purification of highly reactive metals which would normally be contaminated by any or all crucible materials. The successful floating zone refining of such metals is accomplished by using a static inert atmosphere in a hermetically sealed all-glass system. The apparatus is said to be simple to construct, easy to operate, while providing a maximum of reliability from the development of leaks. There is an "absolute minimum" of contamination from gaseous impurities during the long melting procedure.
- (R&D by the Franklin Institute, Laboratories for Research and Development. Details available through military channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C. Ask for Report AFOSR-TN-60-693)
- ☐ CRYSTAL STUDY DEVICE: The Navy has redesigned a standard crime laboratory bullet holder for basic research on the physical properties of materials. A Bausch & Lomb holder, used to rotate bullets for examination under a microscope, was converted for the study of whisker-like crystals of beryllium oxide. The crystals under study are so small that it takes about 1500 to reach across the head of a pin. The studies are part of a program to improve and develop beryllium as a technological material with a high strength-to-weight ratio.
- (R&D by Applied Physics Department, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.)
- ☐ BRAKE WHEEL CYLINDER STORAGE: The Army has been investigating the storage properties of mineral oils with hydraulic brake cylinder components. Brake cylinders were packaged with two types of mineral oil and placed in warehouse storage, and simulated vehicle storage. Cylinders were inspected at one year intervals. After three years of storage all aluminum, tin, steel and brass parts were found to be in excellent condition, but cast iron cylinder walls were excessively pitted. This may have been caused by a new nitrile type synthetic rubber brake cup developed to be compatible with petroleum base brake fluids.
- (Details available through military channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C. Ask for Aberdeen Proving Ground Report CCL #92)

- PERFORMANCE OF UNDERGROUND RADIO INSTALLATIONS: The efficiency of buried antennae and the amplitude and phase of low- and very-low-radiofrequency ground wave signals over distances up to 5,000 miles are discussed in two National Bureau of Standards papers now available. Loop antennae in small radomes were found to be more efficient for transmitting underground and underwater radio signals than line antennae using the same quantity of wire. A computer program was used to determine the amplitude and phase of signals with frequencies from 100 cycles per second to 1000 kc.

(Preprint available. Write National Bureau of Standards, Office of Technical Information, Washington 25, D. C. for Paper 65DL-106, entitled "Useful Radiation from an Underground Antenna." NBS Technical Note No. 60, "Amplitude and Phase of Low- and Very-Low-Radiofrequency Ground Wave" is available at 75 cents from OTS, Dept. of Commerce, Washington 25, D. C.)

- NUCLEAR ROCKET NOZZLE COOLING: New preliminary design studies of Rover-type nuclear rockets by the National Aeronautics and Space Administration show that the originally planned regenerative cooling scheme using liquid hydrogen propellant may not be adequate. Improved nozzle cooling methods now under study include: increasing pressure in the regenerative system well above normal; film cooling; and changes in nozzle construction materials from nickel or stainless steel to refractory-coated or thin, highly-conductive walls which allow a higher operating temperature. Original plans for Rover-type rockets were patterned closely after conventional liquid rocket engine practice to maintain a substantial safety margin. However, it was not possible to carry through with these plans. Even though the hydrogen propellant has a very large heat sink capacity, it will not absorb heat at an adequate rate under normal regenerative cooling system operating pressures.

(Details available in Technical Note D-482 which may be obtained by writing to the National Aeronautics and Space Administration, Washington 25, D. C., ATTN: Code BID)

- HIGH INTENSITY ELECTRONIC FLASH: The Navy has developed a high-intensity electronic flash system which maintains its light evenly at peak brilliance and suddenly shuts off without an afterglow. The device provides illumination for a high-speed camera which takes 82 pictures of a missile model undergoing re-entry airflow tests. The flash unit is a gaseous discharge tube coupled with an artificial transmission line made up of a number of charged capacitors. When these are discharged, alternating current keeps the arc burning evenly for three one-thousandths of a second. As the light abruptly ceases to shine without afterglow double exposures with the high-speed camera are avoided. The electronic system is said to have a number of advantages when compared with chemical flash lamps and flash bombs.

(R&D by B. J. Crapo, L. L. Hill and T. Marshall, Gas Dynamics Division, Ballistics Department, Naval Ordnance Laboratory, White Oak, Silver Spring, Md.)

- CONFIDENCE LIMIT COMPUTER: Studies for the Atomic Energy Commission by the Sandia Corp. have resulted in the development of a novel, pocket-sized "Confidence Limit Computer" expected to be of value in many development or production engineering situations. The device is said to be particularly applicable in evaluations of reliability and quality control.

(Computer and instructions available. \$1.25. Write OTS, U. S. Department of Commerce, Washington 25, D. C. for SCR-159--A Confidence Limit Computer)

P U B L I C A T I O N C H E C K L I S T

- ☐ SYNOPTIC METEOROLOGY, the basic manual prepared by the staff of the National Weather Analysis Center discussing basic techniques by which broad scale hemispheric flow patterns are analyzed for their effect on individual weather systems. 35 Pages. 25 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Synoptic Meteorology -- The NAWAC Manual)
- ☐ HASP PROGRAM, a comprehensive report on the Defense Department's High Altitude Sampling Program including details of findings on fallout from atomic tests, instrumentation and the use of the U-2 aircraft for sample collections. Dated June, 1960 and now available. 228 Pages. (Ask for DASA Report 532B available through military channels or at \$3.50 from OTS, U. S. Department of Commerce, Washington 25, D. C.)
- ☐ SONIC FAILURE RESEARCH FACILITY, an industrial (Bolt, Beranek and Newman, Inc.) report for the Air Force on a unique sonic failure research facility constructed for testing flight vehicle structures and electronic systems in the presence of high intensity sound. 35 Pages (Ask for WADD Technical Report No. 59-12 available through military channels or at \$1.25 from OTS, U. S. Department of Commerce, Washington 25, D. C.)
- ☐ RADIATION PROBLEMS IN MANNED SPACE FLIGHT, the proceedings of a June, 1960 conference sponsored by the National Aeronautics and Space Administration discussing present-day knowledge and required further studies connected with radiation effects on the space traveler. 99 Pages. Single Copies Free. (Write NASA, 1520 H Street, N. W., Washington 25, D. C., ATTN: CODE BID for NASA Technical Note D-588)
- ☐ SPACE & NUCLEAR ENERGY, a progress report on the development of nuclear systems for space propulsion by Harold B. Finger, Manager, AEC-NASA Nuclear Propulsion Office. 15 Pages. Single Copies Free. (Write Information Office, NASA, 1520 H Street, N. W., Washington 25, D. C. for Release 60-306)
- ☐ TEST METHODS FOR ELECTRONIC AND ELECTRICAL COMPONENTS, a detailed Military Standard publication which establishes uniform methods for testing electronic and electrical component parts, including basic environmental tests. 104 Pages. 65 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Publication No. D 7.10:202 B)
- ☐ MARINE SCIENCES RESEARCH, the first in a new series of pamphlets summarizing work in progress at various institutions under Atomic Energy Commission Contract. 50 Cents. (Write OTS, U. S. Department of Commerce, Washington 25, D. C. for Marine Sciences Research, TID 4040)
- ☐ MASS SPECTROMETER STUDIES, a description of the design of a dual-inlet system which permits both high and low mass samples to be run by using a single instrument. Studies in cooperation with the University of Wisconsin. 8 Pages. Single Copies Free. (Write Publications-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa., for Report of Investigation No. 5663)
- ☐ AERODYNAMICS FOR NAVAL AVIATORS, a Defense Department textbook designed to present the elements of applied aerodynamics and aeronautical engineering directly related to flying operations. 416 Pages. Fabrikoid Binding. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for Publication No. D 217.2:Ae 8)

Research and Development Directory

AIR FORCE DEVELOPMENT DIVISIONS -- CENTERS (continued)

AIR FORCE CAMBRIDGE RESEARCH CENTER

L. G. Hanscom Field, Mass.

Telephone: CRestview 4-6100

Contractor Relations & Sources:

J. F. Condon Ext. 2244

Small Business Specialist:

J. F. Condon Ext. 2244

THE HANSCOM COMPLEX:

USAF organizations representing research and development, logistics, and operator-user commands have joined forces at L. G. Hanscom Field, in Bedford, Massachusetts, to make a concurrent, coordinated approach to the task of providing electronic systems for command and control of aerospace forces. Command and control systems, often referred to as "L" systems are those major electronic systems used for collecting, transmitting, processing, and displaying information for command decisions and for control of forces, weapons, and aerospace vehicles.

Establishment of such electronic system management organizations as ARDC's Air Force Command and Control Development Division (AFCCDD), informally known as C²D²; AMC's Electronic Systems Center (ESC); ADC's Command and Control Defense Systems Office (CCDSO); and other Air Force operator-user command systems offices at a single location at Hanscom along with the System Program Offices (SPOS), lends a new nickname to the installation -- THE HANSCOM COMPLEX.

The Hanscom Complex includes the Air Force research Division's Cambridge Research Laboratories which conducts and sponsors basic studies in electronics and geophysics. Massachusetts Institute of Technology's Lincoln Laboratory, with its specialized scientific competence, and The MITRE Corporation with its scientific advisory staff, are members of The Complex. In addition, the Rome Air Development Center (RADC), although located in Rome, New York, outside the physical confines of The Complex, is considered conceptually a part of it. RADC, with its extensive laboratories and test facilities for electronic research and development, supports The Complex in system planning and development and is the primary development agency with The Complex for sub-systems and components.

Hanscom Complex projects are:

- ✓ 412L - AIR WEAPONS CONTROL SYSTEM. An oversea theater tactical air weapons control and warning system.
- ✓ 413L - EXTENSION OF DEWLINE. A distant early warning system for detecting hostile air-breathing threats approaching the North American Continent from the north.
- ✓ 416L - SAGE AIR DEFENSE SYSTEM. A semi-automatic area air weapons control and warning system for detecting, identifying, tracking, and providing interceptor-weapon director against air-breathing threats to the United States and Canada.
- ✓ 425L - NORAD COMBAT OPERATIONS CENTER. A system which collects, processes, and displays data to assist the Command-in-Chief, North American Air Defense Command (NORAD) in commanding and controlling his forces.
- ✓ 431L - TRAFFIC CONTROL AND LANDING SYSTEMS. A program to satisfy Air Force traffic control requirements by working with the Federal Aviation Agency (FAA) and development of equipment peculiar to Air Force needs.
- ✓ 433L - WEATHER OBSERVATION AND FORECASTING SYSTEM. A global semi-automatic electronic system for observing, forecasting, and handling weather information. It is being developed in conjunction with FAA and the U. S. Weather Bureau.
- ✓ 438L - INTELLIGENCE DATA-HANDLING SYSTEM. A system for high-speed processing of world-wide intelligence data.
- ✓ 465L - STRATEGIC AIR COMMAND AND CONTROL SYSTEM. A system which collects, processes, and displays data to assist the Command-in-Chief, Strategic Air Command (SAC) in commanding and controlling his forces.

Research and Development Directory

Hanscom Complex projects (continued)

- ✓ 466L - ELECTROMAGNETIC INTELLIGENCE SYSTEM. A world-wide system for collecting intelligence by electromagnetic means and processing for transmission to users.
- ✓ 473L - AIR FORCE CONTROL SYSTEM. A data processing and display system to assist Headquarters USAF in making command decisions.
- ✓ 474L - BALLISTIC MISSILE EARLY WARNING SYSTEM. A system to provide early warning of a mass ICBM attack on the North American Continent from the north.
- ✓ 480L - AIR COMMUNICATIONS SYSTEM. A system to assure inter- and intra-system communications services to support global Air Force operations.
- ✓ 496L - SPACE TRACK. A system for detecting, tracking, identifying, and cataloging orbiting objects.

AIR FORCE OFFICE OF SCIENTIFIC
RESEARCH (AFOSR)
19th & East Capitol Sts., N. E.
Washington 25, D. C.

Contractor Relations & Sources:
S. Milnovsky Ext. 281
Small Business Specialist:
S. Milnovsky Ext. 281

Telephone: LIncoln 6-5650

Interests - Lets contracts for basic research

POINTS OF CONTACT FOR RESEARCH INFORMATION AT AFOSR

✓ Directorate of Aeronautical Sciences

Fluid mechanics, aerodynamics, structures, and solid mechanics, and basic phenomena in propulsion.

✓ Directorate of Chemical Sciences

Chemical bonding; Surface chemistry and Catalysis; Photochemistry; Non-equilibrium kinetics; High temperature reactions and materials; and Nuclear chemistry.

✓ Directorate of Life Sciences

The nervous system; Molecular biology; Photosynthesis; Psychology (including physiological psychology); Sociology (including group dynamics and intergroup relations); Anthropology; and related fields in the behavioral sciences.

✓ Directorate of Mathematical Sciences

Systematic advancement and invention of mathematical techniques. Theoretical areas of interest include analysis, geometry, probability theory, modern algebra, topology, and logic. A program is being started in the broad area of information complexes, including mechanical translation, automatic speech analysis, automatic abstracting and indexing, information storage and retrieval, and pattern recognition, machine learning, and artificial intelligence.

✓ Directorate of Physical Sciences

Atomic and molecular physics; Electron physics and electronic research; Statistical mechanics and theoretical astrophysics; Nuclear structure; Nuclear interactions; elementary particles.

✓ Directorate of Solid State Sciences

Broad concepts mechanisms governing atomic and molecular phenomena which are essential to the behavior and function or growth and degradation of matter in the solid state.

